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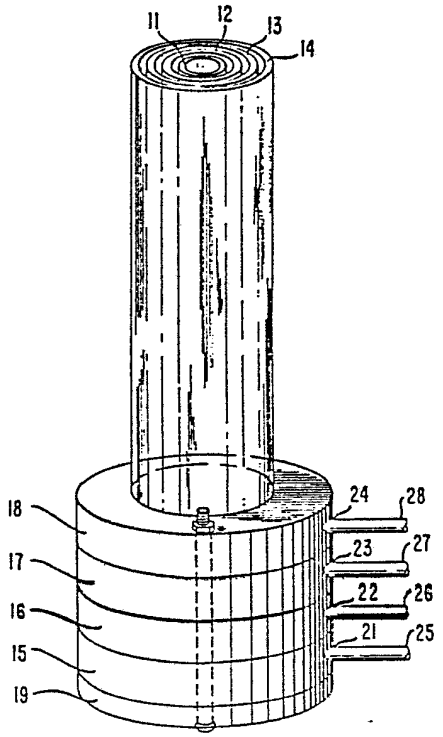
(54) Title: UNIVERSAL TORCH

(57) Abstract

A universal torch, having the feature of ease of assembly and modification, for use, for example, in the fabrication of optical fiber preforms by the VAD method, comprises a plurality of feed tubes (11-14) of arbitrary size and shape, each of which terminates at one of a plurality of separable base chambers (15-18). The latter are assembled, together with the feed tubes, to form the torch structure. Material sources supply (via tubes 25-24) the different preform precursor materials to the respective chambers which, in turn, feed the materials to each of the plurality of feed tubes.



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UNIVERSAL TORCH

Technical Field

This invention relates to universal torches and, in particular, to torches for use in fabricating optical fiber preforms by means of the vapor-phase axial deposition (VAD) method.

Background of the Invention

In the vapor-phase axial deposition (VAD) method of fabricating optical fiber preforms, materials such as $SiCl_4$, $GeCl_4$, $POCl_3$ and BBr_3 are fed into an oxy-hydrogen torch, and the fine glass particles produced by a flame hydrolysis reaction are deposited onto the end surface of a rotating support member. (See U. S. Patent No. 3,966,446.) The porous preform thus formed is then consolidated into a transparent preform by heating.

Torches currently used to form the glass soot are unitary fused silica glass structures comprising a plurality of coaxially aligned cylindrical tubes with means for feeding the various materials to the several cylinders. Due to the difficulty of working with fused silica and the specific geometric requirements of the torch, such as concentricity of the tubes, the torches are somewhat difficult and expensive to make. Additionally, once made, there is no way to change any of the dimensions (i.e., length and/or diameter) of any of the torch tubes if, for example, it would appear desirable to change one or more of the parameters of the fabrication process. Instead, a totally new torch must be made at considerable cost and much delay.

Summary of the Invention

A torch, in accordance with the present invention, can be assembled and disassembled in a matter of minutes, and the various components changed as desired.

The torch comprises a plurality of feed tubes, each of which terminates at and is connected to a separable base chamber. The latter are bolted together to form the torch structure. Feed sources supply the different materials to the respective chambers which, in turn, feed the materials to each of the several tubes.

Brief Description of the Drawings

FIG. 1 shows, in perspective, a first embodiment of a torch in accordance with the present invention;

FIG. 2 is a section through two of the base chambers, showing their structural details;

FIGS. 3-6 show alternate feed tube configurations;

FIG. 7 shows a unitary feed tube assembly; and

FIG. 8 shows a chamber arrangement to accommodate a unitary feed tube assembly.

Detailed Description

Referring to the drawings, FIG. 1 shows a first embodiment of an adaptable torch, in accordance with the present invention, comprising a plurality of coaxially aligned circular cylinders 11, 12, 13, 14, each of which terminates at and is secured to a separable, hollow base chamber 15, 16, 17, 18, respectively. The manner in which the feed tubes are secured to the base chambers will depend upon the materials used. Advantageously, the tubes are made of fused silica and the chambers are made of stainless steel. For this particular combination, the tubes are secured to the chambers by an epoxy adhesive. The bottommost base chamber 15, which terminates the smallest diameter, innermost tube 11, is sealed at its base by means of a base plate 19. The entire assembly is bolted together by suitable means, such as nuts and bolts, one of which 20 is shown in FIG. 1.

The materials of combustion and other reactants are introduced into the several chambers through apertures 21, 22, 23 and 24 in the sidewalls of the respective chambers. In the illustrated embodiment of

FIG. 1, pipes 25, 26, 27 and 28 are shown inserted into the chamber apertures. These pipes are also secured to the chambers in a manner dictated by the particular materials.

From each chamber, the material flows into the connecting feed tube through a second aperture in the chamber wall, as shown more clearly in FIG. 2 which is a section taken through the center of the bottommost chamber 15 and the next adjacent chamber 16. In this figure, the flow of material into the respective chambers is readily apparent. For example, material entering chamber 15 flows up through feed tube 11 through aperture 32, as indicated by arrow 29. Material in chamber 16 enters feed tube 12 through aperture 33 and flows up the torch in the annular region between feed tube 12 and 11 as indicated by arrow 34. Similarly, though not shown in FIG. 2, materials entering chamber 17 flows up tube 13 in the annular region between tubes 12 and 13, while materials entering chamber 18 flows up tube 14 in the annular region between tubes 13 and 14.

Flexible O-rings 30, 31 are advantageously included about the periphery of the chamber surface in contact with the next adjacent chamber or base plate to provide airtight seals and to isolate each flow within its respective chamber.

The principal advantage of the present invention resides in the ability to readily change tube lengths and tube diameters by the simple expedient of unbolting the torch assembly and replacing any one or more of the tubes and its associated base chamber. A particular tube can also be shortened and reinserted. Thus, when used as a torch in the fabrication of optical preforms, the fabrication parameters can be readily changed without having to manufacture a completely new torch. This is a particularly attractive feature of the invention when one is experimenting with the fabrication process and would like to make a range of adjustments before deciding on a final torch configuration. An additional advantage is the

fact that the assembly can be fabricated with the spacing between adjacent tubes precisely controlled so that the resulting arrangement is totally concentric.

While four tubes have been shown in the illustrative embodiment, it is clear that more or fewer tubes can be used as required.

A further advantage of a universal torch, in accordance with the present invention, is the fact that it is uniquely suited to accommodate a wide variety of torch geometries and arrangements which would otherwise be very difficult, if not impossible to fabricate. Some of the various torch cross sectional geometries that can be employed are illustrated in FIGS. 3 to 5. These include, respectively, a rectangular torch 40, a hexagonal torch 41, and a star torch 42. Obviously other geometries can be devised.

FIG. 6 shows an alternate arrangement of feed tubes. In the arrangements illustrated in FIGS. 1-5, the feed tubes are coaxially aligned. In the embodiment of FIG. 6, the feed tubes are arbitrarily placed relative to each other. For purposes of illustration one circular feed tube 60, and two rectangular feed tubes 61 and 62 are shown disposed within a third rectangular feed tube 63.

The several tubes 64, 60, 61 and 62 are fed through base chambers 64, 65, 66 and 67, respectively. To isolate the several chambers, seals are provided wherein a tube passes through a chamber. For example, a seal 70 is provided to isolate chambers 64 and 65 where tube 61 passes from the one chamber to the other. Similarly, seals 71 and 72 are provided where tube 62 passes between adjacent chambers.

Once a torch design has been defined, the several feeds are advantageously formed as a unit by the insertion of spacers between the feed tubes and fusing the spacers to the tubes. Thus, for example, in the concentric arrangement of feed tubes illustrated in FIC. 7, spacers 83-1, 83-2 and 83-3 are symmetrically disposed

between feed tubes 80 and 81. Similarly, a second set of spacers 84-1, 84-2 and 84-3 are symmetrically disposed between feed tubes 81 and 82. To make a permanent assembly that can be handled as a unit, the spacers are fused to the feed tubes. If, for example, silica feed tubes are used, silica rods can be employed as spacers.

It is an advantage of this arrangement that if the feed tubes wear or are damaged during use, the feed tube assembly can be readily removed and a new one inserted into the base chambers in its stead. To accommodate a plug-in and pull-out feed tube assembly, the base chambers are provided with O-ring seals, as illustrated in FIG. 8. Instead of permanently bonding the feed tubes to the base chamber assembly, the feed tubes are held in place by rings 92, 93 and 94 which provide a pressure seal between the tubes and the base chambers. A flat plate 95 and an addition O-ring 96 can be included on the uppermost chamber 90 to provide a further anchor for the tube assembly.

It will be noted, however, that in all cases the base chambers are separable. As such, individual chambers can readily be replaced to accommodate a new torch configuration.

What is claimed is:

1. A torch comprising:

a plurality of feed tubes (11-14);

CHARACTERIZED IN THAT

each of said tubes terminates at one of a plurality of separable base chambers (15-18);

each base chamber having a first aperture (21) for inserting material therein, and a second aperture (32) for allowing material to flow between each chamber and the tube terminating thereat;

and means for holding said chambers together.

2. The torch, according to claim 1, comprising a plurality of coaxial, circular cylindrical feed tubes (FIG. 1).

3. The torch, according to claim 1, comprising a plurality of coaxial, rectangular feed tubes (FIG. 3).

4. The torch, according to claim 1, comprising a plurality of coaxial, hexagonal feed tubes (FIG. 4).

5. The torch, according to claim 1, comprising a plurality of coaxial, star-shaped feed tubes (FIG. 5).

6. The torch, according to claim 1, wherein said tubes are bonded together (83-1) to form a unitary assembly;

and wherein said assembly is insertable, as a unit (FIG. 8), into said base chambers.

7. The torch, according to claim 1, comprising a plurality of feed tubes of different cross sectional dimensions and shapes (FIG. 6).

FIG. 1

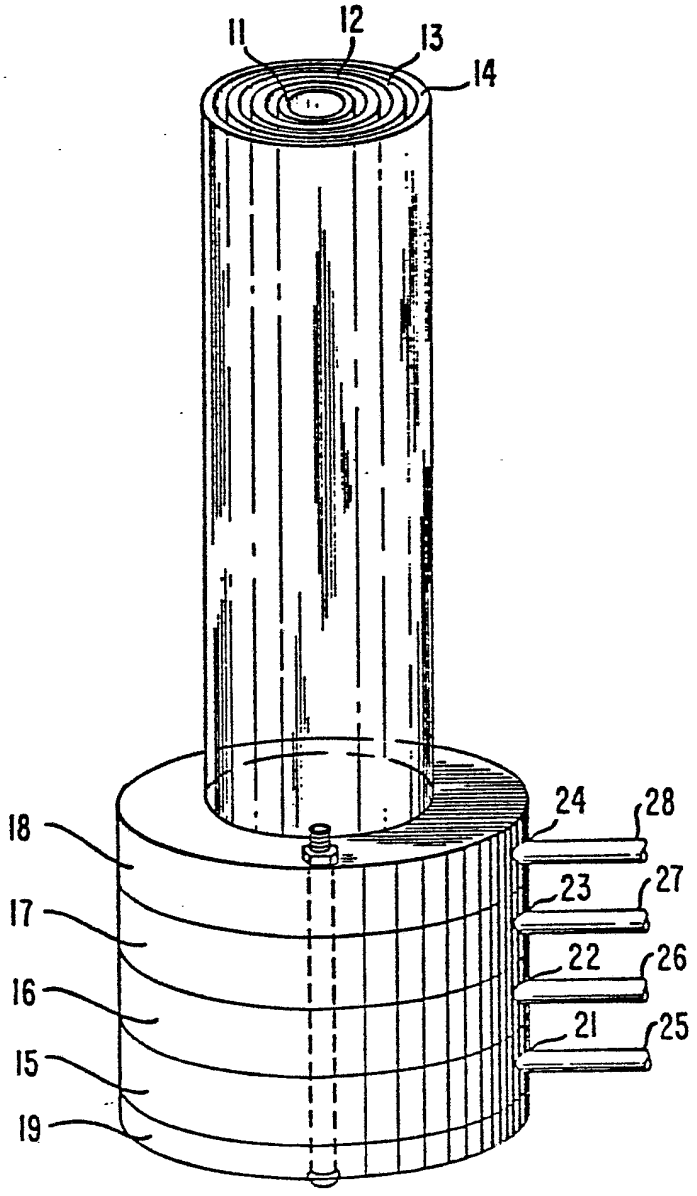


FIG. 2

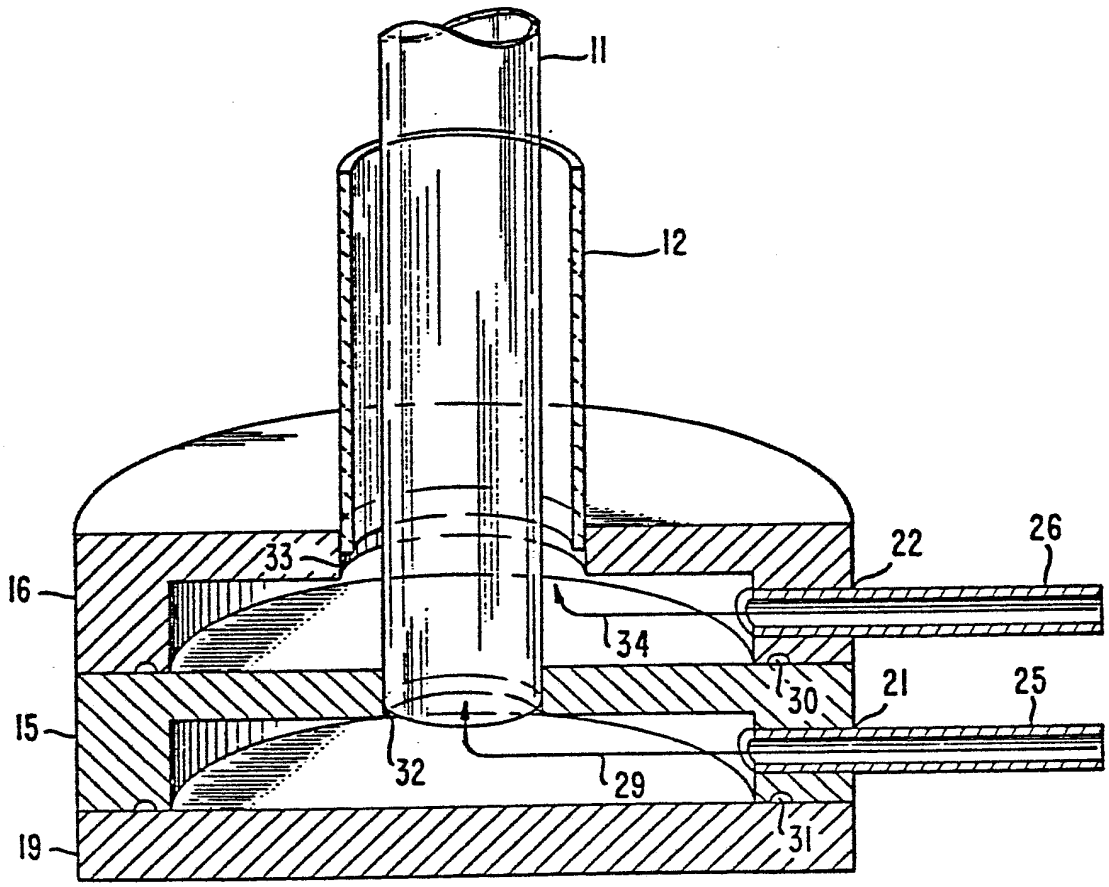


FIG. 3

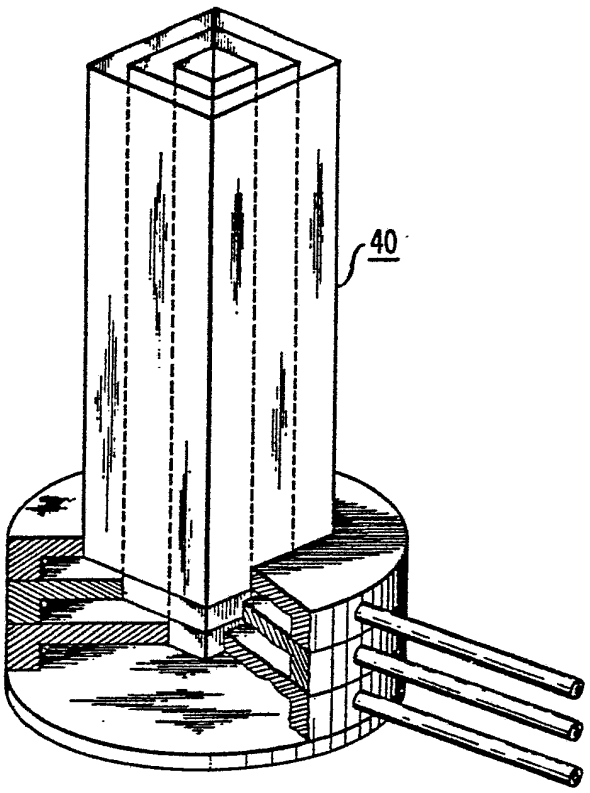


FIG. 4

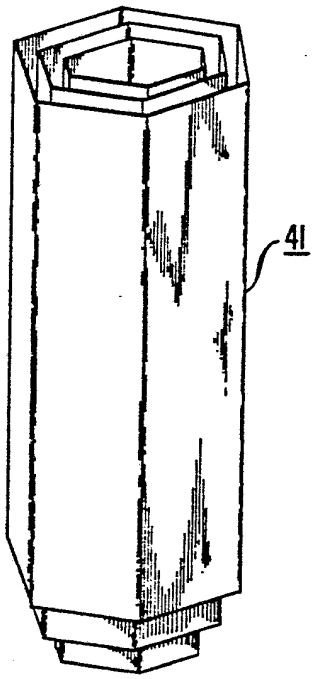


FIG. 5

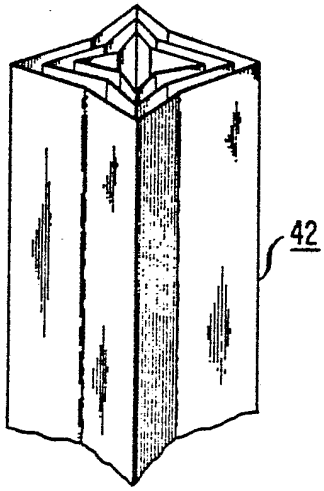


FIG. 6

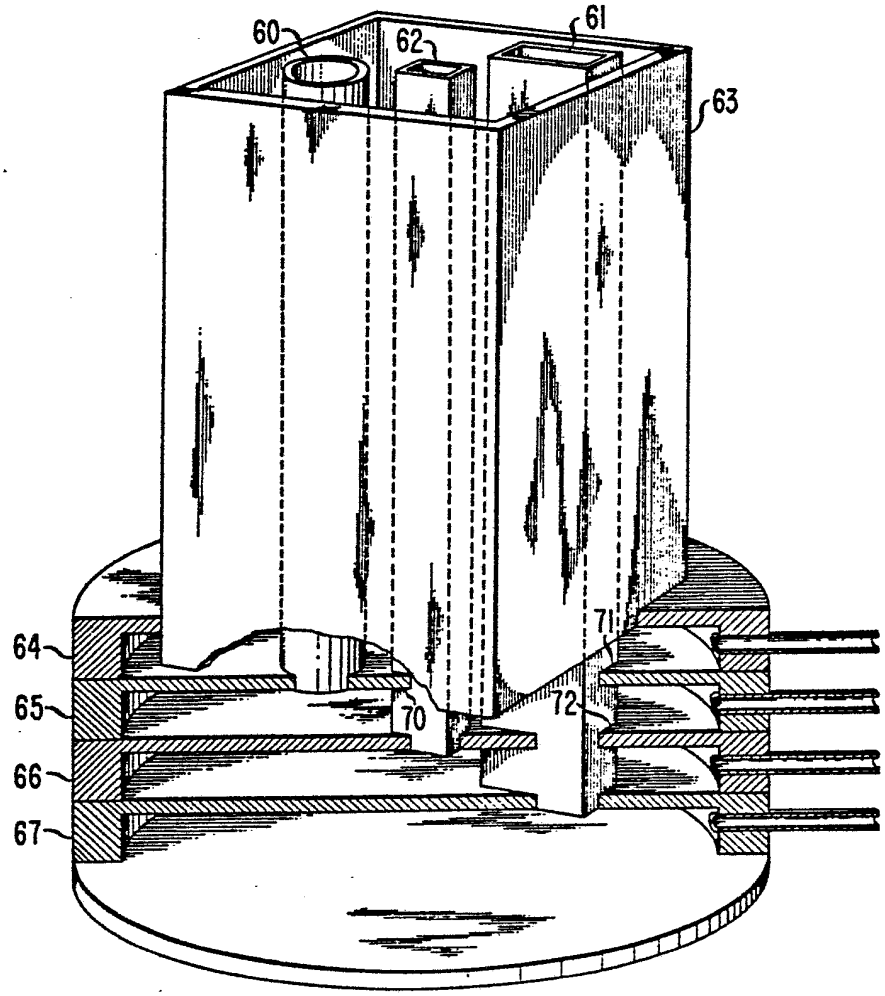


FIG. 7

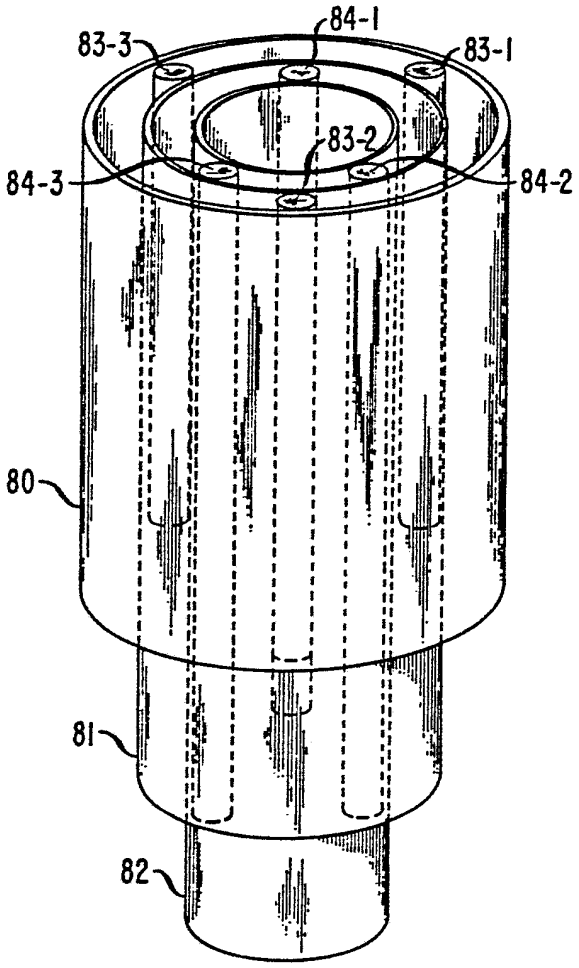
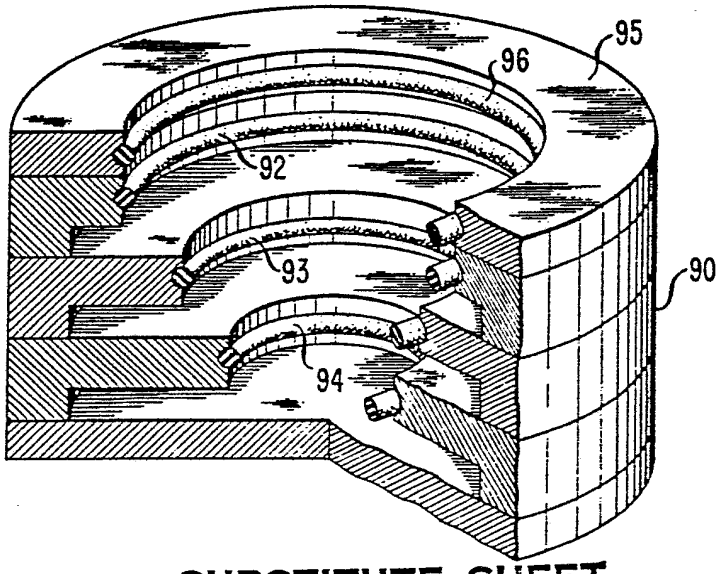


FIG. 8



INTERNATIONAL SEARCH REPORT

International Application No PCT/US 82/00375

I. CLASSIFICATION OF SUBJECT MATTER (if several classification symbols apply, indicate all) [3]

According to International Patent Classification (IPC) or to both National Classification and IPC

Int. Cl.[3] B05B 1/00, 1/14, 7/06 F23D 11/10
U.S. Cl. 239/423, 424, 561, 600

II. FIELDS SEARCHED

Minimum Documentation Searched [4]

Classification System	Classification Symbols
US	239/390, 391, 422, 423, 424, 561, 600

Documentation Searched other than Minimum Documentation to the Extent that such Documents are Included in the Fields Searched [5]

III. DOCUMENTS CONSIDERED TO BE RELEVANT [14]

Category *	Citation of Document, [16] with indication, where appropriate, of the relevant passages [17]	Relevant to Claim No. [18]
A	US, A, 4,155,702, Published 22 May 1979, Miller et al.	
Y	US, A, 3,891,195, Published 24 June 1975, Mill, Jr., et al.	6
Y	US, A, 3,276,694, Published 04 October 1966, Alexander.	1-2,5-6
Y	US, A, 2,121,948, Published 28 June 1928, Borland.	5
X	GB, A, 14,153, Published 18 October 1887, Henwood.	1-2,5-6

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IV. CERTIFICATION

Date of the Actual Completion of the International Search [2]	Date of Mailing of this International Search Report [2]
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International Searching Authority [1]	**Signature of Authorized Officer [20]**
ISA/US	Paul A. Sobel

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